MULTIMEDIA UNIVERSITY

STUDENT ID NO

MULTIMEDIA UNIVERSITY

FINAL EXAMINATION

TRIMESTER 3, 2019 / 2020

PEL0016 - ELECTRICITY AND MAGNETISM

(Foundation in Engineering)

XX JUNE 2020
2.30 p.m. – 4.30 p.m.
(2 Hours)

INSTRUCTIONS TO STUDENTS

1. This question paper consists of **FIVE (5)** printed pages excluding the cover page and appendices, with **FOUR (4)** questions.

2. Answer **ALL** questions. The distribution of the marks for each question is given.

3. Please write all your answers in the Answer Booklet provided.

QUESTION 1 (15 marks)

a) A point charge, Q (1 μC) is 4 cm from a wire carrying 5 A of current. Calculate
   i) magnetic field, B due the wire at position Q. [3 marks]
   ii) the force exerted on Q moving at 2 ms^{-1}. [3 marks]
   iii) if the point charge Q is replace with electron moving at 10 ms^{-1}. Calculate the force exerted the electron. [3 marks]

b) Two parallel wires are 6 cm apart. Each wire carries 8 A flowing in the opposite direction. Calculate the magnetic field, B at P, located 3 cm from the wire. [6 marks]

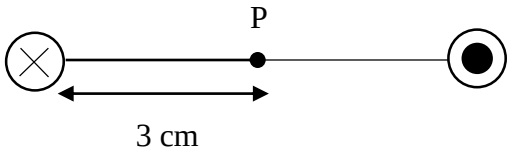

Figure 1

QUESTION 2 (15 marks)

a) Apply Kirchhoff's Laws for the circuit in **Figure Q2(a)**. Calculate:
   i) the total equivalent resistance [6 marks]
   ii) the total current, I_T. [2 marks]

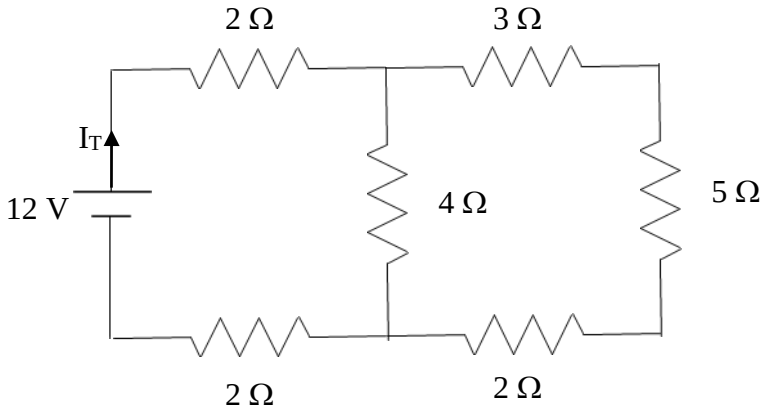

Figure Q2(a)

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b) Calculate Thevenin's Voltage, V_{TH} and Thevenin's resistance, R_{TH} for **Figure Q2(b)**. [7 marks]

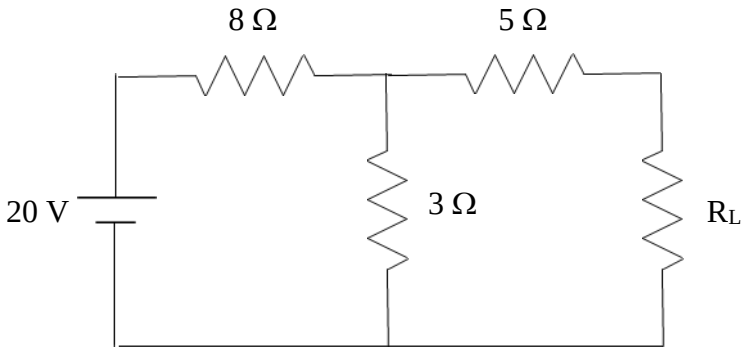

Figure Q2(b)

QUESTION 3 (10 marks)

a) The electrical output of wall socket V_{rms} = 240 V and I_{rms} = 13 A. Calculate
   i) the maximum voltage [2 marks]
   ii) the maximum current [2 marks]
   iii) the rms power [2 marks]

b) A 110 Ω resistor and a 2.2 μF capacitance is connected in series. The circuit is to operate at 60.0 Hz. Calculate the impedance of this circuit. [4 marks]

QUESTION 4 (10 marks)

a) With reference to Figure Q4(a). Given I_C = 7.56 mA, I_B = 213 μA. Calculate
   i) I_E [2 marks]
   ii) β_{dc} [2 marks]
   iii) State the biased condition for BC and BE. [2 marks]

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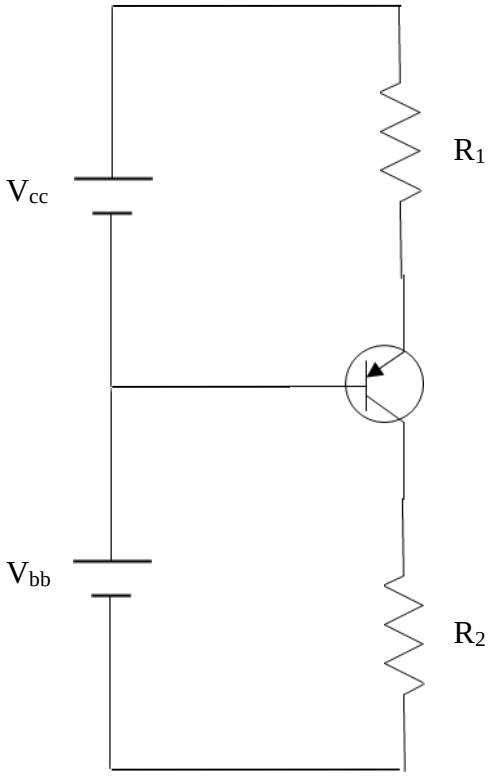

Figure Q4(a)

b) **Figure Q4(b)** shows the input to a rectifier circuit. Sketch
   i) output of a half wave rectifier [2 marks]
   ii) output of a full wave rectifier [2 marks]

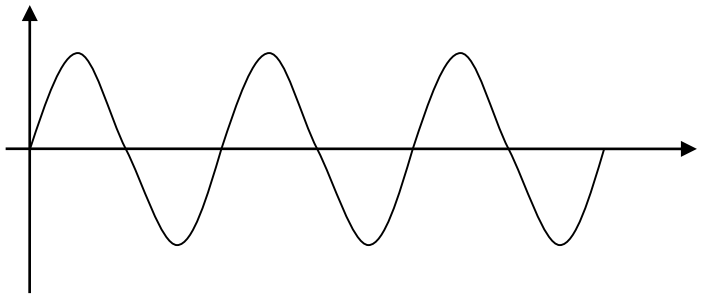

Figure Q4 (b)

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APPENDIX 1

Physical Constants

Quantity	Symbol	Value
Electron mass	m_e	9.11×10^{-31} kg
Proton mass,	m_p	1.67×10^{-27} kg
Elementary charge	e	1.602×10^{-19} C
Gravitational constant	G	6.67×10^{-11} Nm^2kg^{-2}
Gas constant	R	8.314 $J(K.mol)^{-1}$
Hydrogen ground state	E_o	-13.6 eV
Boltzmann's constant	k_B	1.38×10^{-23} JK^{-1}
Compton wavelength	λ_c	2.426×10^{-12} m
Planck's constant	h	6.626×10^{-34} J.s
Speed of light in vacuum	c	3.0×10^{8} ms^{-1}
Rydberg constant	R_H	1.097×10^{7} m^{-1}
Acceleration due to gravity,	g	9.81 ms^{-2}
Atomic mass unit (1u)	u	1.66×10^{-27} kg
Avogadro's number	N_A	6.023×10^{23} mol^{-1}
Threshold of intensity of hearing	I_o	1.0×10^{-12} Wm^{-2}
Coulomb constant	k	8.988×10^{9} Nm^2C^{-2}
Permittivity of free space	ε_o/κ_o	8.85×10^{-12} $C^2(N.m^{-2})$
Permeability of free space	μ_o	$4\pi \times 10^{-7}$ Hm^{-1}

Energy equivalent of atomic mass unit:
One atomic mass unit (1.0 u) is equivalent to 931.5 MeV

APPENDIX II

List of formulas

$$A_v = \frac{V_c}{V_b}$$

$$\alpha_{dc} = \frac{\beta_{dc}}{\beta_{dc}+1}$$

$$\beta_{dc} = \frac{\alpha_{dc}}{1-\alpha_{dc}}$$

$$B = \frac{\mu_0 I}{2\pi r}$$

$$B = \mu_0 nI$$

$$\xi = V + Ir$$

$$\xi = blv$$

$$\xi = -N\frac{\Delta\Phi}{\Delta t}$$

$$\xi = -L\frac{dI}{dt}$$

$$\xi = -M\frac{dI}{dt}$$

$$F = BIL\sin\theta$$

$$F = qvB\sin\theta$$

$$\frac{F}{\ell} = \frac{\mu_0 I_1 I_2}{2\pi d}$$

$$f_r = \frac{1}{2\pi\sqrt{LC}}$$

$$I_{tot} = \sqrt{I_R^2 + (I_L - I_C)^2}$$

$$I = neA(v_n + v_p)$$

$$I = nev_d A$$

$$I = I_{max}\sin\omega t$$

$$I_{rms} = \frac{I_{max}}{\sqrt{2}}$$

$$I_x = \left(\frac{R_T}{R_x}\right) I_T$$

$$L = \frac{N\Phi_B}{I}$$

$$L = \frac{\mu_o N^2 A}{l}$$

$$M = \frac{N\Phi_B}{I}$$

$$M = \frac{\mu_o N_1 N_2 A}{l}$$

$$P = IV = I^2 R = \frac{V^2}{R}$$

$$P_t = I_{rms} V_{rms}\cos\phi$$

$$P_r = V_{rms} I_{rms}\sin\phi$$

$$P_a = I_{rms}^2 Z$$

$$R = \frac{\rho L}{A}$$

$$R = R_0\left[1 + \alpha\left(T - T_0\right)\right]$$

$$R_T = R_1 + R_2 + R_3 + \ldots$$

$$\frac{1}{R_T} = \frac{1}{R_1} + \frac{1}{R_2} + \frac{1}{R_3} + \ldots$$

$$r = \frac{mv}{Bq}$$

$$\tau = NBIA\sin\theta$$

$$U = \frac{1}{2}LI^2$$

$$U = \frac{1}{2}B^2 A\frac{l}{\mu_o}$$

$$V_H = Bvd$$

$$V = V_{max}\sin\omega t$$

$$V_{rms} = \frac{V_{max}}{\sqrt{2}}$$

$$V_x = \left(\frac{R_x}{R_T}\right) V_S$$

$$X_C = \frac{1}{2\pi fC}$$

$$X_L = 2\pi f L$$

$$Z = \sqrt{R^2 + \left(X_L - X_C\right)^2}$$

$$\oint B.dl = \mu_o I$$

$$d\mathbf{B} = \frac{\mu_O I}{4\pi}\frac{d\ell \times \hat{\mathbf{r}}}{r^2}$$

$$\Phi_B = BA\cos\theta$$

$$\cos\phi = \frac{R}{Z}$$

$$\tan\phi = \frac{X_L - X_C}{R}$$